

Part 1. Report Cover

Retest Report Number: N/A

Retest Report Date(s): N/A

Replacement Report Number(s): 97AYP003
DODPOPHM/AYP/TR94008
DODPOPHM/AYP/TR89004

Original Report Number: 99AYP006

Original Report Date: 2 Aug 99

Revision Date(s): N/A

Title: Performance Oriented Packaging Testing of an
MS27683 Removable Head Drum, 16-Gallon, Containing
Packaged Solids (71 lb Gross) - Packing Groups
I, II, and III (All Modes)

Performing Activity: LOGSA Packaging, Storage,
and Containerization Center
ATTN: AMXLS-T
11 Hap Arnold Boulevard
Tobyhanna, PA 18466-5097

Responsible Individual: Francis S. Flynn

Performing Activity's Reference(s): 9HTNR; TE 35-97;
TE 32-94; AMC 13-88

Report Type: Interim Final

DTIC Distribution: N/A

Requesting Organization(s):
Defense Logistics Agency
Defense Distribution Center
ATTN: DDC-TO
2001 Mission Drive
New Cumberland, PA 17070

Requesting Organization's Reference(s):
Memorandum, DOSO-DH, subject: Performance Oriented Packaging
Tests to be Performed in 1999, 1 Oct 98

Part 2. Test Results: ___ single X combination ___ composite

Section I. Pre-test Conditions

For testing reported herein, a shipment of drums was received in new condition. Drums from the lot from which this drum was taken have also been performance tested with a variety of bottles and cans.

The following identification schema designates the packaging specimen used for the test(s) indicated. Assignments were made at random, in no particular order of sequence.

<u>Specimen No.</u>	<u>Test</u>
A	repetitive-shock vibration test flat onto bottom, drop test flat onto sidewall seam, drop test flat onto top, drop test diagonal onto bottom chime, drop test diagonal onto top circumferential edge, drop test stack test

Part 2. Test Results: ___ single X combination ___ composite

Section II. Summary

	<u>SPECIMEN</u>	<u>ALL</u>
A. Drop test - 1.8 m		PASS
flat onto the bottom	PASS	
flat onto sidewall seam	PASS	
flat onto the top	PASS	
diagonally onto bottom chime	PASS	
diagonally onto top circumferential edge	PASS	
B. Leakproofness test - restrained under water/soap over seams		N/A
production testing, 20 kPa, 5 min.	N/A	
design qualification, 20 kPa, 5 min.	N/A	
salvage drum requirement, 20 kPa, 5 min.	N/A	
C. Internal pressure/Hydrostatic pressure test (liq.) -		N/A
D. Stacking test - static load; 2,000 lb, 24 hr		PASS
E. Vibration standard - repetitive-shock, rotary motion		
3.53 Hz., 1 hr		PASS
F. Water resistance test (fiberboard box) -		N/A
G. Compatibility test (liq. in plastics) -		N/A

To be certifiable, the configuration must pass the applicable tests for the type packaging, intended lading, and mode(s) of shipment. This report is/~~is not~~ applicable to transportation by air, and ~~is~~/is not applicable to liquids.

Part 2. Test Results (continued)**Section III. Discussion**

Note. Alpha designations denote which specimen tested in that orientation.

A. Drop test: 49 CFR §178.603

- ☐ cold conditioned (0° F, 72 hr)
☒ ambient conditions
☐ standard conditions (50% RH & 23° C)

No.	Ht.	Orientation	Results
A ¹	1.8 m	Flat onto drum bottom	Pass. No leaks/rupture; entire contents retained
A ¹	1.8 m	Flat onto drum sidewall seam	Pass. No leaks/rupture; entire contents retained
A ¹	1.8 m	Flat onto drum top	Pass. No leaks/rupture; entire contents retained
A ¹	1.8 m	Diagonally onto bottom chime, at/near seam	Pass. No leaks/rupture; entire contents retained
A ¹	1.8 m	Diagonally onto top chime, at/near bolt	Pass. No leaks/rupture; packaged solids retained completely within the drum; loose-fill material had settled.

Note 1. Specimen A is a combination packaging consisting of a 16-gal MS27683 removable head drum (outer packaging) containing packaged solids.

B. Leakproofness test: 49 CFR §178.604

N/A. Leakproofness testing is not required for configurations of solids.

C. Internal Pressure/Hydrostatic Pressure test: 49 CFR §178.605

N/A. Testing for the maintenance of internal pressure is not required for configurations of solids.

D. Stacking test: See 49 CFR §178.606.

- ☐ standard conditions (23° C & 50% RH)
☒ ambient conditions (~72° F)
☐ high temperature conditions (104° F)

No.	Length	Type	Load/Force	Peak Force	Results	Stability Maintained?
A ¹	24 hr	Static	2,000 lbf ²	N/A lbf	Pass. No leakage	Yes

Note 1. Specimen A, 16-gallon MS27683 removable head drum, tested empty.

Note 2. The minimum top load (355 lb) to be applied was greater than the minimum required for the configuration packed with solids.

Part 2. Test Results: Section III (continued)**E. Vibration test:** See 49 CFR §178.608.

No.	Frequency	Duration	Results
A ¹	3.53 Hz	1 hr	Pass. No leakage, rupture, or damage ²

Note 1. Specimen A is a combination packaging consisting of a 16-gal MS27683 removable head drum (outer packaging) containing packaged solids.

Note 2. The drum remained closed, and the contents were completely retained inside the drum. The drum was not opened before proceeding to the drop test. With the use of a generic product, it was not possible to evaluate whether any actual hazardous lading could leak (leave residue) under conditions of repetitive-shock vibration.

F. Water resistance (Cobb Method) test: 49 CFR §178.516

N/A. This test is only for fiberboard, as required by the standards for fiberboard boxes.

G. Compatibility test (plastics packagings only): N/A

Compatibility testing (a procedure specified in appendix B to part 173, as required by 49 CFR §173.24(e)(3)(ii)) is only required for plastics packagings intended to contain *liquid* hazardous materials.

Part 2. Test Results (continued)

Section IV. Notes

Transportation of liquids is not authorized.

Inner packagings have a tendency to migrate if the loose fill material is not firmly packed.

Variation 4 for selective testing of combination packagings, found in 49 CFR §178.601(g)(4), authorizes each external dimension (length, width, and height) to be less than or equal to the corresponding dimension of the tested design type. This allows lessening of the dimensions to provide a snug fit around the packaged lading. The gross weight of the packaging must not exceed the tested weight, and the thickness of cushioning cannot be less than the thickness used in the tested configuration.

For air transportation, **a new gasket, which has never been applied, must be used,** if the drum is to be capable of maintaining the designated internal pressure per 49 CFR §173.27(c).

Part 3. Test Personnel

- A. Drop test** (49 CFR §178.603)
- B. Leakproofness test** (49 CFR §178.604) - N/A
- C. Internal pressure/Hydrostatic pressure test**
(49 CFR §173.27) - N/A
(49 CFR §178.605) - N/A
- D. Stacking test** (49 CFR §178.606)
- E. Vibration standard** (49 CFR §178.608)
- F. Water resistance standard** (49 CFR §178.516) - N/A
- G. Procedure for Testing Compatibility and Rate of Permeation
in Plastic Packaging and Receptacles**
(49 CFR §173.24, app B to part 173) - N/A

The personnel who performed the aforementioned testing, or had a role in the testing, evaluation, and/or documentation, as reported herein are recorded in the test files.

Part 4. References

A. Title 49 Code of Federal Regulations, Parts 173 and 178, October 1, 1998 edition

B. International Air Transport Association Dangerous Goods Regulations, 40th edition, 1 January 1999

C. ASTM D 4919, Specification for Testing of Hazardous Materials Packagings

D. ASTM D 999, Standard Method for Vibration Testing of Shipping Containers

E. ASTM D 951, Standard Test Method Water Resistance of Shipping Containers by Spray Method

F. TAPPI Standard: T 441 Water Absorptiveness of Sized (Non-Bibulous) Paper and Paperboard (Cobb Test)

G. Recommendations on the Transport of Dangerous Goods, sixth revised edition, United Nations, New York, 1990

H. DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/MCO 4030.40A, Packaging of Hazardous Material, 23 Jul 96

Part 5. Equipment

Item	Manufacturer	Calibration	
		Serial No.	Expiration Date
6-inch dial calipers	Brown & Sharp Switzerland	599-5794	2/00
1,250-lb vibration table	L.A.B Skaneateles, NY	8120179	<i>see note</i>
4,000-lb vibration table	Gaynes Engr. Co. Franklin Park, IL	G20765	<i>see note</i>
12,000-lb vibration table	M/RAD Woburn, MA	563-84	<i>see note</i>
30,000-lb compression tester	Gaynes Engr. Co. Franklin Park, IL	G20950	4/00
5,000-lb compression tester	L.A.B Skaneateles, NY	1107050	4/00
10,000-lb scale	J.J. McIntyre & Sons Whitehall, PA	5931A	4/00
5,000-lb scale	Fairbanks Scale USA	H519240	4/00
500-lb scale	Toledo Scale Worthington, OH	N/A	4/00
5,000-gram scale	Ohaus Corporation USA	20078	N/A (new)
3,000-gram balance	Brinkmann Instruments Westbury, NY	3103120	4/00
release hook	Gaynes Engr. Co. Franklin Park, IL	18211-1	N/R
drop tester	L.A.B Skaneateles, NY	3811	N/R
cold chamber	Russells Holland, MI	1962214	4/00
altitude chamber	American Research Corp. Farmington, CT	5A13622	4/00
32-channel chart recorder	Molytek, Inc. Pittsburgh, PA	870403007-2S	5/99
Cobb Sizing Tester	Teledyne Curley Troy, NY	4180-A	N/R
30 psi pressure gauge	WIKA Instrument Corp. Lawrenceville, GA	961420001	4/00
100 psi pressure gauge	WIKA Instrument Corp. Lawrenceville, GA	961420002	4/00
torque wrench (150 ft.-lb)	Stanley-Proto Covington, GA	WWE30966	6/99
torque wrench (100 ft.-lb)	Stanley-Proto Covington, GA	WUK50305	7/99
torque wrench (50 in.-lb)	Stanley-Proto Covington, GA	5A98	N/A (new)
torque wrench (200 in.-lb)	Stanley-Proto Covington, GA	WYC22958	N/A (new)

Note. Equipment is calibrated in accordance with International Safe Transit Association test equipment verification requirements.

Part 5. Equipment (continued)

Item	Manufacturer	Serial No.	Calibration
			Expiration Date
400 kPa pressure gauge	Ashcroft Stratford, CT	45323-016A	11/00
400 kPa pressure gauge	Ashcroft Stratford, CT	5323-016B	11/00
100 kPa pressure gauge	Ashcroft Stratford, CT	59694-011B	11/00
100 kPa pressure gauge	Ashcroft Stratford, CT	59695-011A	11/00

Appendix A

Test Applicability

Based on the drop height and computed stacking weight, this test report is applicable for all surface modes of transportation (road, rail, and water), as well as both cargo and passenger air, when the solid hazardous substance intended for containment by the tested packaging is as described in this report. Transportation by commercial (cargo and passenger) or military air is as permitted by regulation for the hazardous item. The appropriate packaging paragraph for the lading applies. **Transportation of liquids is not authorized.**

Pass/fail conclusions were based on the particular drum specimens, test loads, and the limited quantities submitted for test. Extrapolation to other materials, other manufacturers, other applications, different inner packagings, container sizes, or lesser inner quantities is the responsibility of the packaging design agency or applicable higher headquarters. Extrapolation of test results based on less than the minimum recommended number of test specimens is also the responsibility of the packaging design agency or applicable higher headquarters.

Reference to specification materials has been made based either on the information provided by the requester, the manufacturer, or the markings printed on, attached to, or embossed on the packagings.

Testing was performed per *Title 49 Code of Federal Regulations; Subtitle B, Other Regulations; Chapter I, Research and Special Programs Administration (DOT); Subchapter C, Hazardous Materials Regulations; Part 173, Shippers- General Requirements for Shipments and Packagings; Part 173 Subpart A, General; as well as, Part 178, Specifications for Packagings; and Part 178 Subpart M, Testing of Non-Bulk Packagings and Packages.*

Performance testing was undertaken and completed at the request of an agency responsible for shipment of the dangerous good(s). **The completion of successful required performance tests does not, by itself, authorize the marking and transportation of the dangerous good(s). Applicable modal regulations should be consulted concerning the relationship of performance testing completed and the dangerous good(s).**

The required performance tests are intended to evaluate the performance of the packaging components. The criteria used to evaluate packaging performance is whether the contents of the packaging are retained within the outer packaging, should damage to

Appendix A (Continued)

the outer packaging occur, and secondly, if any inner packaging of hazardous materials leaks, ruptures, or is damaged so as to affect transportation safety. The successful completion of the required tests does not ensure the undamaged delivery or survivability of the actual commodity/item. Separate testing is necessary to assure the stability of any explosive item.

Before a configuration can be certified by the person(s) authorizing shipment, the appropriate packaging for the particular hazardous lading and mode of transportation must be determined, and the item(s) must be prepared for shipment per applicable regulations. The chosen configuration must have been performance tested in accordance with the size, the shape, and the weight constraints posed by the configuration to be certified. The testing reported herein should not be construed as blanket certification of any configuration that simply uses the performance tested drum. Packaging paragraphs apply.

Appendix B

Test Data Sheet

Section I. Test Product

Physical State: X solid liquid gas aerosol

Test Product Used: Dry cell batteries;

BA-270/U (qty 12); 7-1/2 in. high, 2-11/16 in. long, 2-7/16 in. wide

Amount Per Container:

30 lb (2½ lb ea)

Test Weight: ~32.5 kg

Gross Weight: ~71 lb (Gross Weight = Test Weight x 2.205 lb/kg, rounded)

Consistency/Viscosity: N/A

Flash Point: N/A

Additional Description: N/A

Appendix B (Continued)**Section II. Test Parameters****Drop Height:** Ref: 49 CFR §178.603

- X **1.8 m**; 71 in. (PG I, II, & III, SG ≤ 1.2 or **solids**)
 1.2 m; 47 in. (PG II & III, SG ≤ 1.2 or solids)
 0.8 m; 32 in. (PG III, SG ≤ 1.2 or solids)
 m; in. (other, PG , SG)
 from-- PG I: SG x 1.5 m, SG x 59.06 in.
 PG II: SG x 1.0 m, SG x 39.37 in.
 PG III: SG x 0.67 m, SG x 26.38 in.

Unless otherwise computed for more dense liquids, water (SG = 1) represents a solution having a specific gravity of 1.2 or less. Equivalent specific gravity derived from drop height as follows--

PG factor x density (or SG) = drop height, thus
 SG = drop height/PG factor (49 CFR §178.603)
 0.67 m x SG = 1.8 m, thus SG = 2.7, PG III

Internal Pressure/Hydrostatic Pressure (liquids only):

- N/A; *surface only* [49 CFR §178.605(a)]
 X **N/A; solids** [49 CFR §178.605(a)]
 250 kPa (36 psi); *PG I single minimum*
 [49 CFR §178.605(d)(3), surface & 49 CFR §173.27(c)(3)(ii), air]
 100 kPa (15 psi); *PG II/III single minimum*
 [49 CFR §178.605(d)(3), surface & 49 CFR §173.27(c)(3)(ii), air]
 80 kPa (12 psi); *PG III of Class 3 or Division 6.1 sgl min.*
 [49 CFR §173.27(c)(3)(ii), air]
 95 kPa (14 psi); *inner/supplementary minimum, PG N/A*
 [49 CFR §173.27(c)(2)(i), air]
 75 kPa (11 psi); *inner/suppl. min., PG III of Cl 3/Div 6.1*
 [49 CFR §173.27(c)(2)(i), air]
 15 psi/103.4 kPa; *other, drum specification* [MIL-D-6054]
 kPa/ psi; *other, _____*

Stacking Weight/Force: Ref: 49 CFR §178.606**Solids--** $A = (n-1)(w)(.95)$

where: A = applies load in pounds
 n = minimum number of containers that when stacked,
 reach a height of 3 m (round up to next integer)
 w = maximum weight of one packed container in pounds
 .95 corresponds to maximum fill (95% max. capacity)

- 355 **lb minimum required; 2,000 lbf actual**
 $A = (n-1)(w)(.95)$
 where: n = 118 in./21.5 in.
 = 5.49 rounded up to 6
 w = 71 lb (presumed to be 95% of max. capacity)
 $A = (6-1)(71) = 355 \text{ lb}$

Appendix B (Continued)**Section II. Test Parameters (continued)****Stacking Weight/Dynamic Compression Force:** Ref: 49 CFR §178.606**Liquids--** $A = (n-1)[w + (s)(v)(8.3)(.98)](c)$

where: A = applied load in pounds

n = minimum number of containers that when stacked,
reach a height of 3 m (round up to next integer)

s = specific gravity of lading

w = maximum weight of one empty container in pounds

v = actual capacity of container
(rated capacity + outage) in gallons

8.3 corresponds to the weight (lb) of 1 gallon of water

.98 corresponds to maximum fill (98% max. capacity)

c = either 1.5 (the compensation factor that converts the static load
of the stacking test into a load suitable for dynamic compression
testing), or 1.0 (static top load)

N/A lb **minimum required (PG I, SG 1.2);** N/A lbf actual $A = (n-1)[w + (s)(v)(8.3)(.98)](c)$

where: n = 118 in./ in.

≈ rounded up to

 $w = + () () + \approx \text{lb}$

s = 1.2

 $v = (L) / (L / \text{gal}) () \approx \text{lb}$

c = 1

 $A = (-1) [+ (1.2) () (8.3) (.98)] (1) \approx \text{lb}$

N/A lb **minimum required (PG II, SG 1.8);** N/A lbf actual $A = (n-1)[w + (s)(v)(8.3)(.98)](c)$

where: n = 118 in./ in.

≈ rounded up to

 $w = + () () + \approx \text{lb}$

s = 1.8

 $v = (L) / (L / \text{gal}) () \approx \text{lb}$

c = 1

 $A = (-1) [+ (1.8) () (8.3) (.98)] (1) \approx \text{lb}$

N/A lb **minimum required (PG III, SG 2.7);** N/A lbf actual $A = (n-1)[w + (s)(v)(8.3)(.98)](c)$

where: n = 118 in./ in.

≈ rounded up to

 $w = + () () + \approx \text{lb}$

s = 2.7

 $v = (L) / (L / \text{gal}) () \approx \text{lb}$

c = 1

 $A = (-1) [+ (2.7) () (8.3) (.98)] (1) \approx \text{lb}$

Appendix B (Continued)**Section III. Equivalencies of Liquids - Not Applicable**

	Specific Gravity ¹	Total lb per Configuration	Total lb per Container	Gross Weight (pounds) ²	Test Weight (kilograms) ²
water	1.0	-	-	-	-
PG I	1.2	-	-	-	-
PG II	1.8	-	-	-	-
PG III	2.7	-	-	-	-

Note 1. Equivalent specific gravity derived from drop height as follows-- PG factor x density (or SG) = drop height, thus

SG = drop height/PG factor (49 CFR §178.603)

PG I: 1.5 m x SG = 1.8 m, thus SG = 1.2

PG II: 1.0 m x SG = 1.8 m, thus SG = 1.8

PG III: 0.67 m x SG = 1.8 m, thus SG = 2.7

Unless otherwise computed for more dense liquids, water (SG = 1) represents a solution having a specific gravity of 1.2 or less.

Note 2. Gross and test weights include packaging (--- lb, --- kg) and liquid contents. Gross Weight = Test Weight x 2.205 lb/kg, rounded.

Appendix C

Packaging Data Sheet

Section I. Exterior Shipping Container

Packaging Category: ____ single X combination ____ composite

UN Marking(s):

cited in test report-- N/A

marked on packaging-- N/A

UN Type: 1A2; Steel removable head drum (49 CFR §178.504 (a)(2))

Specification Type: Drum, Metal-Shipping and Storage

Specification Number(s): MIL-D-6054; MS27683-1 (drum assembly);
MS276830 (bottom marked); MS27683-60 (lid marked)

Nominal (Rated) Capacity: 16 gal

Container Manufacturer: MIRAX (bottom marking); CAGE 85717
MIRAX Chemical Products, Corporation
St. Louis, Missouri 63139

Nomenclature: Drum, Metal

Date(s) of Container Manufacture: 96 (embossed on bottom)

Material: Steel, 18 gauge (embossed on bottom)

NSN: 8110-00-254-5717 (drum assembly)

Contract No.: N/A

Purchase Order No.: N/A

Tare Weight (empty drum): 22 lb (marked); 22.5 lb (actual)

Dimensions: 17 in. in diameter (OD); 21½ in. in height (OD)
15.38 in. nominal inside diameter (IAW MIL-D-6054)
19.88 in. nominal usable inside height (IAW MIL-D-6054)

Closure (Method/Type):

Locking ring; nut and bolt, tightened to $6 \pm \frac{1}{2}$ foot-pounds

Closure Dimensions: $\frac{3}{4}$ in. in height (OD) (locking ring)
1½ in. around (OD) (locking ring)
 $\frac{3}{8}$ in. by 3½ in. (bolt)

Appendix C (Continued)**Section I. Exterior Shipping Container (continued)**

Closure Specification Number(s):

MS27683-60 (drum cover, style 1); NSN 8110-00-222-3136
 MS27683-80 (locking ring, style 1); NSN 8110-00-190-9994
 MS27683-90 (gasket); NSN 5330-00-351-1162

Closure Manufacturer(s): Nut & bolt, not marked

Banding Type: N/A Banding Specification No(s): N/A

Banding Dimensions: N/A Banding Manufacturer: N/A

Banding Position(s): N/A

Cushioning/Dunnage: Vermiculite; fiberboard pad

Cushioning/Dunnage Specification Type(s):

Vermiculite-- not identified

Note. Recommended use-- Commercial Item Description,
 Vermiculite, Absorbent (For Packaging Liquid Hazardous Material)

Fiberboard-- Standard Specification for Corrugated and Solid
 Fiberboard Sheet Stock (Container Grade) and Cut Shapes

Cushioning/Dunnage Specification Number(s):

Vermiculite-- N/A

Recommended use-- A-A-52450, NSN: 8135-01-324-2664

Fiberboard-- ASTM D 4727, type CF (corrugated fiberboard)
 Variety SW (singlewall), C flute
 Class WR (weather-resistant)
 Grade V3c

Cushioning/Dunnage Dimensions: see Additional Description

Vermiculite-- Grade 3, ASTM C 516, approximately 19 lb

Fiberboard-- 13.5 in. diameter (pad between layers, qty 1)

Cushioning/Dunnage Manufacturer(s):

Vermiculite-- Not identified; Fiberboard-- Not identified

Leakproof Liner(s): Optional

Note. Using the drum dimensions, if a drum liner used,
 the bag width should be-- the bag depth should be--

[	w_{drum}	+	7]	[	w_{drum}	+	h_{drum}	+	7]
[	15 $\frac{1}{4}$	+	7]	[	15 $\frac{1}{4}$	+	20	+	7]
	22			[	15 $\frac{1}{4}$	+	20	+	7]
							42		

Liner Manufacturer/Distributor and Part No.(s): N/A

Appendix C (Continued)**Section I. Exterior Shipping Container (continued)**

Additional Description:

a. A plastic liner (bag) may be placed in the drum. The use of a leakproof liner or leakproof bag in the drum is optional for this configuration. Per MIL-B-49430 each packaged lithium battery is to be in a sealed polyethylene bag.

b. Fine grade vermiculite (3 in.) was placed in the bottom of the drum. Five batteries, arranged in a circle and one battery in the center, were placed on the vermiculite. More vermiculite was then packed around and over the six batteries. A 1-inch layer of vermiculite covered the batteries. A circular fiberboard pad was placed on the layer of vermiculite. Approximately 1 inch of vermiculite was placed on the fiberboard pad. Six batteries were placed on the vermiculite. Additional vermiculite was then packed around and over the batteries. Vermiculite (3 in.) covered the batteries. Approximately two inches of vermiculite separated the batteries from each other and the sides of the drum. **The vermiculite must be firmly packed, especially toward the drum bottom chime. The vermiculite must completely fill the drum, up to the rim.**

c. Before closing, the drum was "shaken down" to settle and pack the loose-fill material. Additional vermiculite was added, as necessary to make a tight pack. If used, the plastic bag is to be rolled/folded down, then taped across the fold. The bag ends are to be folded down along the sides of the drum.

d. Care must be exercised when selecting vermiculite to avoid introducing water or surfactants (treatments to reduce dust) into the package. Only untreated vermiculite should be used. The use of CID A-A-52450, Vermiculite, Absorbent (For Packaging Liquid Hazardous Materials) is recommended.

e. The packing of lithium batteries may require special provisions for insulation material (vermiculite). The appropriate packaging instruction/paragraph should be consulted before selecting this tested configuration for use.

Appendix C (Continued)

**Section II. Primary Inner Packaging¹ of Combination Packaging
Applicable/~~Not applicable~~**

Note 1. A sealed article satisfies the requirements of the inner packaging associated with the applicable packing paragraph. Reference: (49 CFR §178.601(g)(6))

Quantity of Inner Containers: 12 Capacity: TBD

Specification Type and No(s).: N/A
(lithium batteries to be per MIL-B-49430)

Type/Materials: Packaged solids (lithium batteries)

Manufacturer/Distributor: N/A Date(s) of Manufacture: N/A

NSN: N/A

Tare Weight: N/A Filled Weight: ~2½ lb ea

Closure (Method/Type): N/A

Closure Specification Type(s) and No(s).: N/A

Closure Manufacturer: N/A Closure Dimensions: N/A

Secondary Closure: N/A

Secondary Closure Specification Type(s) and No(s).: N/A

Secondary Closure Dimensions: N/A

Secondary Closure Manufacturer(s): N/A

Cushioning/Dunnage Type: See section I

Cushioning/Dunnage Specification and No(s).: N/A

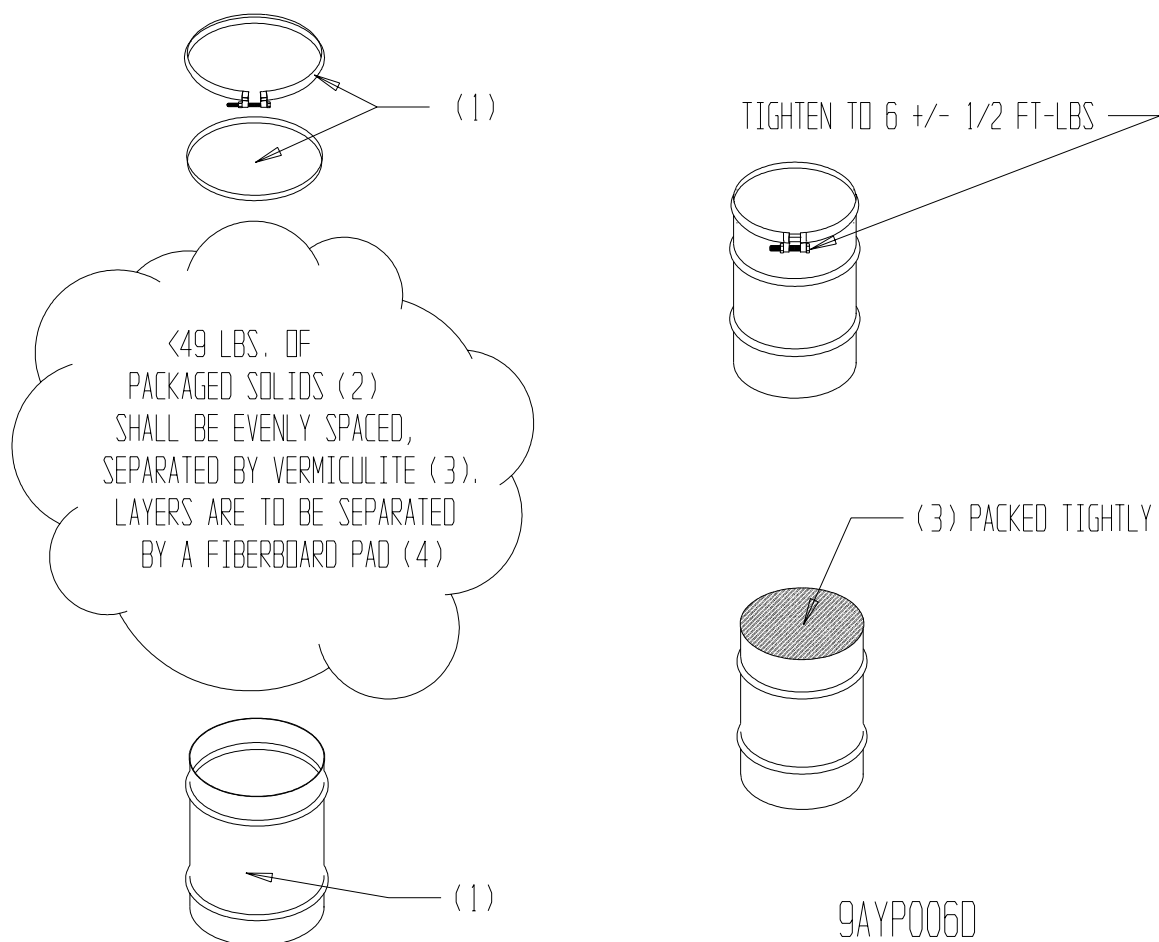
Cushioning/Dunnage Manufacturer: N/A

Leakproof Liner: N/A Static Electricity Protection: N/A

Additional Description: The test load consisted of old, dry cell batteries. The batteries were not packaged, except for being in a heat-sealed polyethylene bag. Each battery was enclosed in a paperboard case.

Appendix C (Continued)

Section III. Drawing



ITEM	DESCRIPTION	99AYP006
1	16 GAL., DRUM, METAL-SHIPPING & STORAGE, OPEN HEAD, IAW MIL-D-6054, NSN: 8110-00-254-5717, MS 27683-1	
-	PLASTIC DRUM LINER, 4-MIL POLYETHYLENE, 22 X 42 IN. (OPTIONAL)	
2	PACKAGED SOLIDS (30 LB OF PACKAGES, 19 LB VERMICULITE) NOTE. LITHIUM BATTERIES SHALL BE PACKAGED IAW MIL-B-49430, i.e., IN A CHIPBOARD/PAPERBOARD BOX, SEALED IN A POLYETHYLENE BAG	
3	VERMICULITE, A-A-52450	
4	FIBERBOARD PAD, GRADE W5c or V3c IAW ASTM D 4727, 13½ IN. DIAMETER	

Appendix D

Rationale

The equivalent of Packing Group I (great danger) testing was requested for a 16-gallon, MS27683 removable head drum, having as the intended contents packaged solids. The configuration to be tested is intended to be applicable to a large assortment of packaged solids of varying constructions and capacities.

Without a designated item, old, dry cell batteries (BA-270/U) were used as a test load. The batteries had been in storage for more than 10 years. Substitution for the actual hazardous item (material) is permitted by 49 CFR §178.602(c).

One combination packaging made to the aforementioned described configuration was subjected to drop, static load (stack), and vibration testing as prescribed in ASTM D 4919. These tests are designed to simulate the shock and vibration a package (configuration) may encounter when being shipped worldwide by truck, rail, or ocean going transport. The order of testing was vibration, then drop testing. After the rough handling testing of the packed drum, static loading was performed on the empty drum. This is a U.S. DOT approved method of stack testing, especially when the combination packaging has wide applications.

In conducting the drop test, the packed drum was dropped first flat onto the bottom, followed by a drop flat onto the sidewall seam, flat onto the top, diagonally onto the bottom chime, and a drop diagonally onto the top chime (circumferential edge). Between all drop orientations, the drum was dropped onto five different surfaces or edges. One drop per drum is the **minimum** per 49 CFR requirements. The decision to use the same container (configuration) for all drops was based on the relatively minimal damage demonstrated during previous testing of the drum with a variety of inner packagings and articles. Five drops per drum exceeds 49 CFR §178.603 requirements, as well as both UN and ASTM recommendations (*i.e., one drop diagonally onto a chime, and one drop on the next weakest part, each orientation repeated three times using six samples total*). The use of one configuration for multiple tests and drops is DOD policy as stated in DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 40302.2/MCO 4030.40, Packaging of Hazardous Material.

For each orientation for the drop test (49 CFR §178.603), a free fall drop table, set for 1.8 meters (71 in.), was used. The impact surface was the ½-inch steel impact plate of the table, which was bolted to the concrete floor.

Appendix D (Continued)

The leakproofness test (49 CFR §178.604) was not conducted on the drum, because the drum is an outer packaging of a combination packaging, and is not intended for the containment of liquids. Leakproofness testing is not required for configurations of solids.

For internal pressure requirements for liquids in inner packagings of combination packagings intended for transportation by aircraft, 49 CFR §173.27(c) applies. Pressure requirements, for lading other than liquids, have not been identified. Testing for the maintenance of internal pressure is not required for configurations of solids.

A 5,000-lb capacity compression tester was used for the stack test (49 CFR §178.606), because it could hold the load constant for the required 24-hour timeframe. The total top load (2,000 lbf) was greater than the minimum required for one drum based on the outside drum height and the maximum gross packaged weight. The top load was to simulate a stack of identical packagings which might be stacked on the packaging during transport. The minimum height of the stack could not be less than 3 meters (118 in.), so the number of packagings (stack height minimum divided by assembled drum height) had to be represented by an integer number, which had to be rounded up, without respect to which was the nearest whole number.

To be in compliance with U.S. Department of Transportation standards for packagings bearing the United States mark (USA) as a component of the packaging certification marking (49 CFR §173.24a(a)(5)), the vibration test (49 CFR §178.608) was performed, as a means to determine capability. The test was conducted as prescribed by ASTM D 999, method A2 (Repetitive Shock Test (Rotary Motion)). The test was run for 1 hour, using the drum packed with solids. The combination packaging was tested using a 1,250-lb vibration table (rotary motion) that had a 1-inch-vertical double amplitude (peak-to-peak displacement) such that the combination packaging was raised from the platform to such a degree that a piece of steel strapping (1.6 mm) could be passed between the bottom of the package and the platform.

The Cobb Method Test for water absorptiveness was not performed, because the test is not a performance test. The Cobb Method Test, addressed in 49 CFR §178.516, Standards for Fiberboard Boxes, is a material specification test only for the fiberboard to be used for outer packagings.

Compatibility testing (a procedure specified in appendix B to part 173, as required by 49 CFR §173.24(e)(3)(ii)) is only required for plastics packagings intended to contain liquid hazardous materials. This procedure, therefore, is not required since the outer drum is made of steel, and the lading is solid.

Appendix E

Actual Product

Note. The item Identification Number and related Proper Shipping Name have not been identified for items to be transported in this configuration.

Name: Explosive No.:

Part No.: Drawing No.:

NSN: Type: DODIC:

Specification: RELCD:

Properties or Descriptions:
(IMO IMDG)

Proper Shipping Name(s):
49 CFR--
IATA/ICAO DGR--
AFJMAN 24-204/TM38-250--
IMO IMDG--

Identification No.: UN Hazard Class or Division:

Packing Group: ___ I ___ II ___ III

49 CFR-- Packaging Authorization(s): §
Exception(s): §
Special Provisions:

IS/IS NOT forbidden on passenger aircraft/rail
kg maximum limitation
IS/IS NOT forbidden on cargo air,
kg gross maximum limitation

ICAO TI/IATA DGR--

Packing Instruction(s): passenger aircraft--
cargo aircraft--

Special Provisions:

IS/IS NOT forbidden by passenger air, ___ kg maximum limit
IS/IS NOT forbidden by cargo air, ___ kg G max. limitation

IATA State Variations:

IATA Operator Variations:

IMO IMDG Code Packagings: Schedule , stowage
Packing Method

Appendix E (Continued)

NSN (continued):

AFJMAN 24-204/TM 38-250--

Packaging Paragraph:

Special Provisions:

WAS/WAS NOT a theta item (duty passengers)

WAS/WAS NOT a dagger item (no passengers)

Note. The theta/dagger designations were eliminated in the 1 Mar 97 revision to AFJM 24-204, and replaced with Special Provisions codes.

Amount Per Container (Configuration): _____ gallons

Net Explosive Weight: kg each
 kg total

Density/Specific Gravity:

Vapor Pressure at 50° C:
 55° C:
 70° F: mm Hg

Flash Point: ___ N/A ___ ° C ___ ° F

Consistency/Viscosity: N/A

Interim Hazard Classification Ref(s): N/A

Electrostatic Discharge Protection: Required/not required

Shelf Life Item? ___ Yes ___ No

Additional Description: N/A